Investigation of Ethylisopropyl Sulfone Medium with a Copper-Based Redox Electrolyte for Ambient Light Dye-Sensitized Solar Cells: Achieving High Efficiency and Enduring Long-Term Stability

Sayah, D., Ghaddar, T. H.

Department of Chemistry

American University of Beirut, Lebanon

In recent years, dye-sensitized solar cells (DSCs) have shown remarkable efficiency levels, particularly under low light conditions, making them promising candidates for indoor applications. However, for these devices to be successfully commercialized, high power conversion efficiencies (PCEs) alone are not sufficient. Long-term stability is a critical aspect that needs to be addressed. Most of the well performing DSCs reported so far have utilized conventional organic solvents, which have low boiling points and are highly volatile. While these solvents contribute to achieving high PCE values, they are prone to leakage and evaporation, limiting the long-term stability of the devices. Herein, we report on cosensitized DSC devices (A–E) with commercial dyes (XY1b/MS5) and different additives. This was accomplished by employing for the first time ethylisopropyl sulfone (EiPS) as a high boiling point solvent along with Cu(I)(dmby)2·TFMSI and Cu(II)(dmby)2Cl·TFMSI as the redox mediators in DSCs. Remarkably, most of the tested DSC devices exhibited exceptional performance, achieving high PCE values ranging from 19% to 23% under 1000 lx irradiation and up to 0.82% under 1 sun simulated solar light irradiation. Our analysis revealed that the N-methylbenzimidazole (NMBI) additive played a crucial role in ensuring both good PCE% and long-lasting durability, particularly in device B. On the other hand, the use of additives such as 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide (ImTFMSI) and/or LiTFMSI resulted in deterioration of the photovoltaic parameters during the long-term stability tests in the EiPS-based electrolyte medium, observed in devices C–E. This knowledge opens up possibilities for further optimization of ambient-light DSCs with improved stability and provides a viable solution for indoor power generation applications.